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A TEST TO MEASURE KNOWLEDGE OF FARMERS ON MITIGATION AND ADAPTATION PRACTICES OF CLIMATE CHANGE IN HILL AGRICULTURAL SYSTEM

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ABSTRACT

An attempt has been made to develop a test for measuring knowledge of farmers on mitigation and adaptation practices of climate change due to the non-availability of a standardized scale to measure the farmers' knowledge level. Pertinent items were collected covering all aspects of mitigation and adaptation practices to climate change in hill agriculture. After getting the jury opinion on the items, thirty-five items were selected and administered to 36 farmers. Finally, 20 knowledge items were included in the final format of the knowledge test based on the difficulty index which ranges from 30 to 70, discrimination index which ranges from 0.25 to 0.75 and point- biserial correlation coefficient. The reliability of the knowledge test was measured with the help of split-half method and reliability coefficients was found to be r=0.69, which indicates that this knowledge test is quite reliable. To administer the knowledge test a respondent is given one mark for each correct answer and zero mark for each wrong answer. The final study was conducted in West Garo Hill district of hill state, Meghalaya where the most agriculturally vulnerable Community and Rural Development (C&RD) block to climate change was selected and 60 farmers were selected randomly. The study revealed that less than 50% of farmers had knowledge about mitigation practices of climate change and a majority of the farmer knew about adaptation practices of climate change. Cumulatively 46.67% respondents come under medium level of knowledge category on mitigation and adaptation practices of climate change.

KEYWORDS: Climate Change, Mitigation, Adaptation, Knowledge Test & Item Analysis

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INTRODUCTION

Climate change is widely acknowledged as foremost among the formidable challenges facing the world today. Though climate change is a global phenomenon, its impacts are regional making some regions more vulnerable than the others. Climate change has brought widespread misery and huge economic losses to India, adversely affecting agriculture. Das and Tripathi (2014) reported that 40% farmers want to quit farming. Active measures of mitigation and adaptation to climate change is not occurring as fast, widely or significantly as may be required to address major climate change impacts.

Understanding the climate change dynamics is very important from adaptation point of view. Climate change is a very complex issue and not only lay people but also the well educated people have difficulties in understating the different concept of climate change. The selection of most appropriate and timely mitigative and adaptative strategies becomes problematic, if one did not understand what to adapt to.

The study has been conducted in hill state of Meghalaya, India. Agriculture is extremely vulnerable to climate change in hill agricultural system both in terms of physical and social aspects. The outcome of climate change in Meghalaya will be excessively high, due to three main reasons- geographical location, high dependence of people on natural resources that are highly sensitive to climate change and low adaptive capacity due to fewer amounts of resources available to them.

A standardized knowledge test which can measure the knowledge of farmers on mitigation and adaptation practices in hill agriculture has not been developed in the past. With this background, the present study endeavours to develop a standardised knowledge test to measure the knowledge level possessed by a farmer on different farming strategies or practices to mitigate and adapt to climate change impact and react to changing circumstances. A knowledge test is a set of questions, each of which has a correct answer, to which people respond (*Roy and Mondal,2004*). Here, knowledge on mitigation and adaptation practices of climate change has been defined as the understanding of the farmers about the causes of climate change and the strategies to mitigate and adapt to climate change at the local level based on their experience. A knowledge test if constructed, by adopting scientific procedure, will determine the knowledge gap, and accordingly, future policy can be planned for better adaptation and capacity building.

MATERIALS AND METHODS

The whole paper is presented in two parts- First part deals with construction of the knowledge test to measure farmers' knowledge on mitigation and adaptation practices in hill agriculture (1) and the second part deals with the measurement of knowledge of farmers (2)

CONSTRUCTION OF THE KNOWLEDGE TEST TO MEASURE FARMERS' KNOWLEDGE ON MITIGATION AND ADAPTATION PRACTICES IN HILL AGRICULTURE

Collection of items

Items about climate change mitigation and adaptation practices were collected from relevant literature, group discussion, personal experience and pilot studies were conducted in the area of investigation. Initially, fifty-five items were collected where 18 items were related to mitigation practices and 37 items relating to adaptation practices of climate change. Items were selected on the basis of their apparent lack of ambiguity, simplicity and representativeness. Necessary care was taken to see that the items were based on the knowledge, which farmers of the hill areas possess. Here, emphasis was given on procedural knowledge and causal relationship than declarative knowledge due to its strong association with environmental behaviour and positive correlation with risk perception (*Renouf, C.R. et al., 2008*).

Jury Opinion

To assess the relative accuracy of the items, experts who are engaged in climate change research, which comprised of scientists from Indian Council of Agricultural Research(ICAR) complex, faculty from the college and extension personnel were asked to evaluate each item according to how accurate or inaccurate they thought it was and to add further suggestions. After screening, fine tuning and editing based on the opinion of the concerned experts, thirty-five

items were selected, 10 items relating to mitigation practices and 25 items relating to adaptation practices of climate change. The selected items were subjected to item analysis to screen some more items based on the opinion of the respondents (other than the final sample) in sample area.

Item Analysis

An item analysis generally yields three kinds of information- item difficulty index, item discrimination index and point bi-serial correlation.(*Yadav,2009*) A pilot study was conducted in East Khasi Hills district of Meghalaya for item analysis and 36 respondents were selected for the present pilot study that were not included in the final test. The score obtained by 36 respondents were summed up and arranged in descending order to divide them in 6 equal groups with 6 respondents in each group. The ranges of the score of the 6 groups are presented in Table 1. For the purpose of further item analysis we eliminate the middle two groups out of six groups.

Table 1: Range of Scores Obtained by the Respondents (G1= Group 1 G6=Group 6)

Group No.	G1	G2	G3	G4	G5	G6
Score Range	19-21	17-19	15-17	14-15	13-14	8-13
No. of respondents	6	6	6	6	6	6

Item Difficulty Index

The item difficulty index was defined as the proportion of the farmers giving correct answer to that particular item. The index indicates the extent to which an item is difficult. Here in the present study, the higher index means a high proportion of farmers gave correct answers to the items.on mitigation and adaptation practices of climate change in hill areas. The difficulty level was calculated using the following formula-

$$P_i = \frac{n_i}{N*100}$$

Where, P_i=Difficulty index for i^{th} item**,** n_i=Number of respondents who correctly answered the i^{th} item**,** N=Total number of respondents to which i^{th} item were administered that is 36 respondents.

Finally, the items with 'p' values ranging from 30 to 70 were considered for the final selection of the knowledge test selected for final test based on the recommendation of Atthouse.L.A (2000) and presented in Table 2.

Item Discrimination Index

The index of item discrimination provides information on how well an item discriminates well informed respondent from poorly informed respondent. The item discrimination index was calculated using the following formula-

$$E^{1/3} = \frac{(S1 + S2) - (S5 + S6)}{N/3}$$

Where, $E^{1/3}$ =Discrimination index for i^{th} item**,** S1, S2 and S5, S6 are the frequencies of correct answers in the groups G1, G2 and G5 and G6 respectively, N = Total number of respondents of the sample selected for the item analysis.

The discrimination index varies from 0 to 1. The items with discrimination index ranging from 0.25 to 0.75 were selected for the final test. (Athouse,2000)

Finally, twenty items were selected based on the items' difficulty level and discriminatory power. The selected items comprised of three formats of question viz. multiple choice, direct questions and fill in the blanks.

Reliability of the Test

Split half reliability method was used to find out the reliability of the test. In this method, all the twenty items were first randomly arranged and then divided into two equal halves one containing the odd items and other one containing the even items. The test was administered to thirty respondents and the two sets of knowledge scores obtained by the farmers were correlated. The co-efficient correlation (r=0.69) was highly significant indicating a high degree of dependability of the test for measuring knowledge of farmers on mitigation and adaptation measures of climate change.

Validity of the Test

The two methods employed to know the validity of the test were jury opinion and point biserial correlation. Content validity was ensured initially by administering every item to different experts for evaluating the representation of universe by the test, its relevance and appropriateness. For establishing internal consistency of each item, point bi-serial correlation coefficient(r_{pbi}) was estimated by using the formula suggested by Garret (1966).

$$r_{pbi} = \frac{Mp - Mq}{SD} \times \sqrt{pq}$$

Where, r_{pbi} = Point bi-serial correlation coefficient, Mp = Mean of the total scores of the respondents who answered the item correctly, Mq = Mean of the total scores of the respondents who answered the item incorrectly, SD = Standard deviation of the entire sample, p= Proportion of the respondents giving correct answer to the item, q = Proportion of the respondents giving incorrect answer to the item (or) q = 1- p.

The calculated point bi-serial (r_{pbi}) correlation of every item determined the construct validity of the test. The items with significant correlation coefficients either at 1 or 5 per cent level were included in the standard knowledge test designed to measure the knowledge of farmers on mitigation and adaptation measures of climate change as depicted in Table 2.

Sampling Method for Measurement of Knowledge Level in Hill Agricultural System

According to IPCC report (2007), the Himalayan ecosystem is one of the highly vulnerable zones after Coastal ecosystem towards climate change in India. The hill state, Meghalaya is facing effects of climate change due to its geo-ecological fragility and strategic location vis-a-vis the eastern Himalayan landscape. Hence, Meghalaya was selected purposively for the present study**.** Gambegri block of West Garo Hills district of Meghalaya was purposively selected as it was one of the most agriculturally vulnerable Community and Rural Development (C&RD) block to climate change. A total of 60 farmers were randomly selected for the study.

RESULTS AND DISCUSSIONS

Knowledge Test Developed

The results of the knowledge test obtained were as follows in Table 2. Out of 55 items, 20 items were finally selected where 8 items represented knowledge on mitigation practices and 12 items on adaptation practices of climate change. The items in the knowledge test were administered to the respondents in the local language and their responses

were recorded in the form of correct or incorrect answers. A weightage of 1 was assigned to correct answer and for incorrect answer, a weightage of "0" was assigned.

Table 2: Difficulty, Discrimination and Point Bi-Serial Correlation for Knowledge Test Items

Item No.	Knowledge Items	Difficulty Index	Discrimination Index	Point Bi-Serial Correlation	S=Selected Item R=Rejected Item
1.	What is climate change?	55.56	0.28	0.11	S
2.	Which of the following gas is more responsible for climate change?	69.44	0.38	0.03	S
3.	Which of the following gas i.e. responsible for climate change emitted due to application of chemical fertilizers in the field?	5.55	0.08	0.31	R
4.	In agriculture, a majority of on-farm carbon dioxide emissions come from?	27.78	0.00	0.08	R
5.	The outcome of climate change in Meghalaya will be excessively high, due to?	94.44	0.08	0.10	R
6.	To minimize the use of non-renewable resources, the best method is?	25.00	0.08	0.05	R
7.	Which of the following is a climate resilient technology?	16.67	0.08	0.01	R
8.	From which of the following practice large volume of carbon dioxide is release into the atmosphere?	47.22	0.32	0.08	S
9	Energy consumption can be reduce by using.....	41.67	0.42	0.08	S
10.	Which of the following will help reduce emission of carbon dioxide?	77.78	0.46	0.34	S
11.	To improve the soil fertility and reduction of weed growth, the best method is.	36.11	0.58	0.35	S
12.	What should be added to improve soil aeration and enriching the soil with micro-organisms?	8.33	0.17	0.47	R
13.	The best way to prevent water scarcity during post monsoon is:	19.44	0.17	0.06	R
14.	How can soil erosion be prevented?	70.00	0.21	0.14	R
15.	What are the measures to reduce soil erosion by wind?	55.56	0.75	0.39	S
16.	Mulching of the soil can be done by using.	63.89	0.42	0.35	S
17.	What can be done to alleviate the problem of low nutrient retention capacity?	2.78	0.00	0.03	R
18.	Soil-water holding capacity can be increased by?	55.56	0.50	0.13	S
19.	To protect crops from climatic abnormalities and unpredictable weather, one should grow crops under?	69.44	0.38	0.07	S
20.	An agronomic management which can help to tackle to climatic stress?	22.22	0.25	0.20	S
21.	What does it mean by adjusting planting calendar/ crop schedule?	27.78	0.48	0.07	S
22.	What does it mean by adjusting planting techniques?	63.89	0.25	0.18	R
23.	Crop and variety diversification means?	33.33	0.57	0.02	S
24.	What should be done to improve the cropping intensity after kharif rice?	25.00	0.00	0.12	R

Table 3: Contd.,					
25.	How can one get their crops insured, incase of crop loss due to certain climatic aberrations?	66.67	0.75	0.34	S
26.	What type of irrigation method should be followed for proper water management?	36.11	0.25	0.08	S
27	The most effective mechanism to tackle the menace of climate change is?	61.11	0.59	0.33	S
28.	Zero tillage means planting	61.15	0.25	0.25	S
29.	To wrath of pest and disease in rice fields organically, we can use?	55.56	0.33	0.08	S
30.	What can be done to overcome flood like situation in wet terrace under rice cultivation.	27.78	0.00	0.02	R
31.	To avoid converting fish ponds into weed infested, the best method to be followed is?	27.28	0.17	0.08	R
32.	Scientific method of pisciculture, include?	11.11	0.17	0.22	R
33.	In order to efficiently use water bodies to increase its biological productivity, the best integrated farming system is?	47.22	0.59	0.33	S
34.	Duck farming has a tremendous scope for farming because.	30.56	0.33	0.39	S
35.	To manage pigs from heat stress related to changing climate, the best method is:	94.44	0.08	0.22	R

Knowledge Level of the Respondents

From Table 3 it is evident that only 33.33% respondents knew about climate change in the area, while more than 70% of the respondents had knowledge on which gas is responsible for climate change, which practice involves releasing of large volume of carbon dioxide into the atmosphere and how to reduce it. Majority of the respondents answered correctly to questions related to adaptation practices. However, only 3.33% respondents knew how to prevent soil erosion. The score was more for the items which they experienced and knowledge on cause effect statements were more than that of factual knowledge about climate change. So, it is of immediate importance to introduce climate change education among the farmers through extension functionaries of different organizations at different levels.

Table 3: Knowledge Test on Mitigating and Adaptation Practices

S. No.	Knowledge Items	Frequency	%
Mitigation Practices			
1.	What is climate change?	20	33.33
2.	Which of the following gas is more responsible for climate change? (a) Water vapour (b) Carbon dioxide (c) Methane	44	73.33
3.	From which of the following practice large volume of carbon dioxide is release into the atmosphere? (a) Application of fertilizers (b) Deforestation (c) Organic farming	43	71.67
4.	Energy consumption can be reduce by using.....	20	33.33
5.	Which of the following will help reduce emission of carbon dioxide? (a) Increase burning of fields (b) Increase green coverage (c) Increase use of resistant variety	54	90.00
6.	To improve the soil fertility and reduction of weed growth, the best method is.	24	40.00
7.	How can soil erosion be prevented?	2	3.33
8.	What are the measures to reduce soil erosion by wind?	16	26.67
Adaptation Practices			
9.	Mulching of the soil can be done by using	47	78.33

10.	Soil-water holding capacity can be increased by? a) Maximizing root depth (b) Adding fertilizers (c) Adding manure	49	81.67
Table 3: Contd.,			
11.	To protect crops from climatic abnormalities and unpredictable weather, one should grow crops under?	12	20.00
12.	An agronomic management which can help to tackle to climatic stress?	23	38.33
13.	Adjusting planting calendar/ crop schedule means? (a) Early planting/harvesting (b) Shortening growing season (c) Planting early maturing crops	43	71.67
14.	How can one get their crops insured, incase of crop loss due to certain climatic aberrations?	45	75.00
15.	What type of irrigation method should be followed for proper water management? (a) Drip irrigation (b) Flood irrigation (c) Sprinkler irrigation	36	60.00
16.	The most effective mechanism to tackle the menace of climate change is? (a) Mono-cropping (b) Intensive Integrated Farming System (c) Crop rotation	15	25.00
17.	Zero tillage means planting	50	83.33
18.	To wrath of pest and disease in rice fields organically, we can use? (a) Fermented bamboos shoots, leaves (b) Spraying of pesticides (c) Scarecrows	23	38.33
19.	In order to efficiently use water bodies to increase its biological productivity, the best integrated farming system is? (a) Duck cum fish integrated farming system (b) Pig cum fish integrated farming system (c) Poultry cum fish cum duck integrated farming system	38	63.33
20.	Duck farming has a tremendous scope for farming because.....	22	36.67

Distribution of Respondents According To Knowledge Level

Respondents were classified into three categories according to their knowledge level using cumulative cube root frequency method (Gunning *et al.,2014*). Only 25% respondents had high level of knowledge about mitigation and adaptation practices of climate change while 28.33% respondents had low level of knowledge. However, a large number of respondents (46.67%) cumulatively fell under medium knowledge category. The findings drew the attention of the policy makers on immediate introduction of climate change literacy through different social institutions.

Table 4: Distribution of Farmers According to their Knowledge Level

Category	Range	Frequency	%
Low	<10	17	28.33
Medium	10-12	28	46.67
High	13-16	15	25.00

CONCLUSIONS

Availability of climate information is a prerequisite for mitigating and adapting the adverse effect of climate variability, and capitalizing on beneficial effect, especially in Meghalaya where the livelihood and even lives of its people depend on natural climate. Hence, improving access to climate information is an important first step to improve the livelihood of people in such variable conditions. Medium level of knowledge base has been found; however better knowledge on mitigation and adaptation practices of climate change were mainly due to experience. So, if experiential knowledge is supplement with scientific evidence, the knowledge acquisition will be more sustaining.

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